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Chapter 1

Geologic Setting and Tectonic Evolution of Porphyry Cu-Au, Polymetallic Replacement, and Sedimentary Rock-Hosted Au Deposits in the Northwestern Area of the Timok Magmatic Complex, Serbia*

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Abstract

A northerly trending zone of porphyry Cu-Au, porphyry Au, polymetallic replacement Pb-Zn-Au-Ag, and sedimentary rock-hosted Au deposits along the northwest margin of the Late Cretaceous Timok Magmatic Complex forms a part of the Bor metallogenic zone in eastern Serbia. The porphyry Cu-Au, epithermal quartz-alunite, and polymetallic replacement deposits in the northwest margin of the Complex represent parts of zoned magmatic-hydrothermal systems that are linked to Late Cretaceous oxidized, hornblende-biotite diorite porphyry intruded over a ~5- to 6-m.y. period between 83.6 ± 0.5 and 78.5 ± 1.3 Ma (U-Pb SHRIMP-RG ages on zircon), making them slightly younger than the larger Late Cretaceous (89–83 Ma) porphyry Cu-Au and high-sulfidation Cu-Au deposits in the eastern part of the Complex. The low-temperature sedimentary rock-hosted Au deposits in the northwest lie spatially near to, but are always separated by faults from, the polymetallic replacement and porphyry Cu-Au deposits. However, the common but not ubiquitous spatial association between the sedimentary rock-hosted Au deposits and the zoned porphyry Cu polymetallic replacement deposits, coupled with available exploration geochemical vectors evident in soil geochemistry, does suggest a genetic linkage between all the hydrothermal deposits.

An important component required to fit the deposit types into a zoned magmatic hydrothermal model is a revised geologic and tectonic understanding that can also be extended to the entire Timok Magmatic Complex. A component of the revised model emphasizes the role of the Cenozoic faults formed during oroclinal bending of the region. Two fault generations are significant. Postmineral easterly trending normal faults bounding basins filled largely by early Miocene sedimentary rocks preserved the low-temperature sedimentary rock-hosted Au deposits and helped preserve deposits in the eastern area of the Complex. These faults accommodated elongation of the Complex and are kinematically linked to dextral strike-slip faults, such as the Timok-Cerna fault system, with as much as 100 km of displacement. Major, postmineral, NW-trending faults dismembered deposits in the northwest and accommodated sinistral displacement, which on a larger scale facilitated rotation between large crustal blocks, as well as Timok Magmatic Complex-scale shortening normal to the Complex during oroclinal bending of the region. The end result of the postmineral deformation during oroclinal bending and extensional and strike-slip deformation is preservation of different crustal levels, not just in the northwest but also throughout the region. The deformation furthermore enhanced the preservation of Cretaceous ore deposits beneath younger rocks. Because the Complex was constructed over a highly faulted Variscan and older basement terrane, it is possible that reactivation of the pre-Cretaceous basement faults in the basement beneath the Complex, such as the Variscan Blagojev-Kamen-Rudaria fault systems, played a role in the Late Cretaceous history of the Bor metallogenic zone, as well as controlling post-Cretaceous deformation in the Complex.

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**A supplemental digital Table for this paper is available online at www.seg-web.org/SP19-Appendices.